Resource Symbiosis Model through bricolage: A livelihood generation assessment of an Indian village

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Abstract

In this study, a conceptual model of resource symbiosis (RSM) of an Indian village was developed, by leveraging the concept of bricolage, to aid in sustainable livelihood generation. This novel RSM expands as a co-management model for a rural community in resource-constrained environments to manage its resources efficiently in collaboration with local governments. Avenues for sustainable livelihood generation was assessed through household surveys and resource mapping of the village. A mixed-mode research method was adopted through participatory rural appraisal activities for involving local people and their practices in the design philosophy of RSM. Problem identification and ranking through personal and collective interviews of the villagers formed a core basis for the livelihood assessment. It enabled the internalisation of normative and idiosyncratic linkages for resource symbiosis. These linkages were interconnected through community participation, which set the boundary conditions for RSM. Results show that RSM for the study village could foster inclusive growth in two ways: first, by creating scope for efficient resource utilization through the establishment of an oil mill, a biogas plant and a milk processing unit; and, second, by creating an entrepreneurial ecosystem based on village's self-sufficiency and market demand by empowering local entrepreneurs. Additionally, RSM could leverage local governing bodies to connect with private investors and policymakers to enable fast-track implementation of the livelihood generation schemes of the government.

Keywords: *Bricolage; Rural India; Livelihood Generation; Sustainable Development; Resource Symbiosis*

The final version of the paper can be downloaded from the Journal of Rural Studies, published by Elsevier. (DOI: 10.1016/j.jrurstud.2018.03.101)

1. Introduction

Amidst rapid urbanisation and profound transformation happening in India, rural communities are still benefitting on a *trickle-down* basis (Breitkreuz *et al.*, 2016). Rural poverty continues to be a significant policy concern, despite India's annual growth rate of 6.8% in 2016 (Planning Commission, 2017). Rural areas in India are defined by its agriculture centric economy, lack of essential services such as health centres, schools, all-weather roads, clean energy, clean water and adequate sanitation provisions (Suneja, 2015; Acharya and Sadath, 2017). Agricultural growth remains pale even after 69 years of independence, forcing deepening poverty upon the fate of farmers (Rao, 2009). The quest for a better quality of life intensifies the influx of rural-urban migration, causing urban areas to accede to severe resource stresses like the shortage of affordable housing, access to a modern form of fuel for cooking, lack of employment opportunities (Bardhan, Kurisu and Hanaki, 2011, 2015). It leads to the formation of *slums* in the cities, which are often characterised as *'dwelling that is unfit for human habitatio*n' (Bardhan *et al.*, 2015, 2018). Thus, bounding a significant portion of the rural population into a vicious cycle of widespread poverty and deprivation, even in the 'shinning' cities, indicating the need for bottom-up developmental strategies for rural communities to curb large-scale migration.

The rural population in India is over two-thirds of the country's total population (i.e. more than 800 million of India's 1.25 billion people), accounting for 75% of all disadvantaged citizens (IFAD, 2015). Rural poverty is mainly centred on the underprivileged classes (80% of the rural poor), i.e. Scheduled Castes (SC) and Scheduled Tribes (ST) (IFAD, 2015). Rural women face harsher plight due to intensive-marginal labour with low wages. Rao (2009) stated that marketisation, technological change, and politicisation of the current rural development policies had enabled newer opportunities for rural communities. However, the inherent weaknesses in these policies are the most significant roadblock to their practical implementation (Breitkreuz *et al.*, 2016). Some of the flagship rural development schemes are Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDUGKJ) (MoRD, 2017a), Integrated Rural Development Program (IRDP) (Saxena, 2017), National Rural Livelihood Mission (NRLM) (MoRD, 2017c) and Mahatma Gandhi National Rural

Employment Guarantee Act (MGNREGA) (MoRD, 2017d). These schemes have the central objective of creating an opportunity for the livelihood generation and rural employment for poverty eradication. Table.1 highlights the brief provisions of these schemes by the Ministry of Rural Development (MoRD), along with the combined schemes by the Ministry of Agriculture (MoA), the Ministry of Women and Child Development (MoWCD) and the Ministry of Health and Family Welfare (MoHFW).

Table 1. List of government schemes/policies for rural development in India (Source: MoRD, 2017)

Sl. No.	Scheme	Ministry	Year	Provisions
1	Deen Dayal Upadhayaya Gram Jyoti Yojana	Ministry of Power (MoP)	2015	Providing 24 X & uninterrupted power supply to all homes in rural areas
2	Deen Dayal Upadhyaya Grameen Kaushalya Yojna	Ministry of Rural Development (MoRD)	2015	Engage rural youth in the underprivileged category in skill development and employment generation activities
3	Gramin Bhandaran Yojana	Ministry of Agriculture (MoA)	2007	Long term storage of farm produce & processing of farm produce. Quality control and marketing of the farm produce.
4	Pradhan Mantri Gramin Awaas Yojana	Ministry of Rural Development (MoRD)	1985	Financial assistance to rural poor for constructing their houses themselves
5	The Indira Gandhi Matritva Sahyog Yojana	Ministry of Women & Child Development (MoWCD)	2010	Provision of cash incentive of Rs. 4000 to the mother (19 years and above) for first two live births
6	Integrated Child Development Services	Ministry of Women & Child Development (MoWCD)	1975	Tackle malnutrition and health problems in children below 6 years of age and their mothers
7	Integrated Rural Development Program	Ministry of Rural Development (MoRD)	1978	Income generation capacity of the target groups through self-employment
8	Janani Suraksha Yojana	Ministry of Health and Family Welfare (MoHFW)	2005	One-time cash intensive to pregnant women for availing skilled assistance during child birth
9	Livestock Insurance Scheme	Ministry of Agriculture (MoA)	2008	Insurance of cattle and their quality control
10	Members of Parliament Local Area Development Scheme	Ministry of Statistics & Programme Implementation (MoSPI)	1993	MP has the choice to work for local development with a funding up to Rs. 5 Crore

11	Midday Meal Scheme	Ministry of Human Resource Development (MoHRD)	1995	Free lunch to school-children on all working days
12	National Social Assistance Scheme	Ministry of Rural Development (MoRD)	1995	Assistance to unemployed, old aged, sickened, disables and underprivileged citizens
13	Pradhan Maintri Adarsh Gram Yojana	Ministry of Rural Development (MoRD)	2010	Integrated development of SC majority villages in 4 states
14	Pradhan Mantri Gram Sadak Yojana	Ministry of Rural Development (MoRD)	2000	Good all-weather road connectivity to unconnected villages
15	Rastriya Krishi Vikas Yojana	Ministry of Agriculture (MoA)	2007	Achieve 4% growth in agriculture during Eleventh FYP
16	Sampoorna Grameen Rozgar Yojana	Ministry of Rural Development (MoRD)	2001	Additional wage employment and food security through a community based capacity building approach
17	National Rural Livelihood Mission (NRLM)	Ministry of Rural Development (MoRD)	2013	Capacity building through Self Help Group (SHGs) and employment generation
18	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)	Ministry of Rural Development (MoRD)	2005	Right-based guarantee of employment for 100 days

Schemes such as MGNREGA offer a unique right-based employment guarantee for 100 days each year, provided that the adult members of the rural household are willing to do unskilled manual labour at the statutory minimum wage of the state or higher (Breitkreuz *et al.*, 2016; MoRD, 2017d). It also ensures a qualified applicant against joblessness within 15 days by providing unemployment insurance. The core goal of this policy is to provide livelihood security and democratic empowerment (MoRD, 2017d). There is a particular inherent shortcoming of this policy such as its significant variability in implementation and uptake across the states in India, causing a non-uniformity in its governance and high variability in the allocation of resources (Khera, 2011; Breitkreuz *et al.*, 2016). Moreover, the number of guaranteed days of work is often less than the policy ceiling of 100 days per year per household. Dreze, (2010) found that in

2006-07, only 17 days of employment were available on average per household. Similarly, Stahlberg, (2012) showed that in 2009-10 the number of days of employment rose to 54 person-days per household, which is way below the guaranteed 100 days of employment. Additionally, Breitkreuz et al., (2016) reported that 'leakages' in the fund allocation process is one of the major bottlenecks to its successful implementation. State-wise empirical evidence by Stahlberg, (2012) showed that there were notable variances in the wage, material and administrative cost allocation process under MGNREGA, in the states of Kerala, Odisha and Tamil Nadu. Moreover, there is evidence that lack of awareness about the employment guarantee schemes in the breadth of rural society and biased employment provisioning are significant bottlenecks in the effective implementation of this policy (Shankar, Gaiha and Jha, 2011; Liu and Barrett, 2013). Inconsistent female participation among the various states is another significant gap of this program (Liu and Barrett, 2013), whereas this program was specifically tailored for the upliftment of the Schedule Cast (SC), Schedule Tribe (ST) and women (MoRD, 2017d). Stahlberg, (2012) also found that in 2009-10, the average number of days of participation for women for the whole of India was 48, 21 for ST and 31 for SC. Similarly, Khera & Nayak, (2009) found that women participation was low as 15% in some districts of Uttar Pradesh, whereas as high as 69% in some districts of Rajasthan, as per NREGA survey of 2007-08. However, Kerala and Tamil Nadu had the highest rate of women participation with over 85% and 80%, respectively (Breitkreuz *et al.*, 2016). Administrative negligence such as over-reporting of wages or false reporting of MGNREGA worker has also been identified as policy bottlenecks that cause systemic corruption and financial leakages (Niehaus and Sukhtankar, 2013).

Nevertheless, literature also suggest several remedies to fill the void in MGNREGA, such as empowering local NGOs to moderate the employment process from the bottom of the pyramid, paying workers through bank account (the current government is trying hard to push ADHAAR based one-account one-identification system), capacity building through 'social citizenship' and by fostering social entrepreneurship (Niehaus and Sukhtankar, 2013; Ruparelia, 2013; Breitkreuz *et al.*, 2016). The provisioning of rights-based approach such as social entrepreneurship is even more empowering for women

because, as it could leverage their Self Help Groups (SHGs) into a process-driven income generation source (Khera and Nayak, 2009; Ruparelia, 2013; Nithyanandhan and Mansor, 2015).

Similarly, National Rural Livelihood Mission (NRLM) is another such progressive initiative by the Government of India (GoI), which aims '*to reduce poverty by enabling the poor households to access gainful self-employment and skilled wage employment opportunities resulting in appreciable improvement in their livelihoods on a sustainable basis, through building strong and sustainable grassroots institutions of the poor*' (MoRD, 2011). It operates on three cohorts: first by enhancing and expanding existing livelihood options of the poor, building employability and nurturing self-employment and social entrepreneurs (MoRD, 2011). In 2015, this program was renamed as Deendayal Antayodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM) to popularise the idea of SHGs to promote self-employment and raise awareness about the community-based capacity building programs. Huma & Hasan, (2017) states that SHGs have been working towards poverty alleviation and social & economic improvement of the poor, in the last 30 years, but they are unsuccessful in converging their efforts towards the fulfilment of their objectives, because *'the scope of SHGs in most cases has remained restricted to financial savings'*. They found five major problems that demotivate SHG members and prevent community level inclusive growth, namely, 'ineffective group meetings, the absence of income-generating activities, lack of cooperation among the members, lack of awareness and a small amount of savings' (Huma and Hasan, 2017). They recommended linking SHGs with banks (Harper, 2002), and enabling the establishment of microfinance institutions, along with capacity building for setting-up small businesses as a group. Existing literature also supports this notion of institutionalization of SHGs to a social enterprise, to enable inclusive growth of the community in sustainable and rapid manner (Bali Swain and Wallentin, 2009; Husain, Mukherjee and Dutta, 2010; Bali Swain and Varghese, 2013; Suprabha, 2014; Nithyanandhan and Mansor, 2015). This forms the principal motivation behind this study, where a village in western India was cross-sectionally studied, to understand the scope of the livelihood generation using its existing resources

by expanding the concept of *'bricolage'* of social entrepreneurship (Di Domenico, Haugh and Tracey, 2010; Desa and Basu, 2013).

Bricolage is defined as *'making do by applying combinations of resources already at hand'* (Baker and Nelson, 2011). It focuses on addressing opportunities and problems with the limited available resources which are free or cheap. In entrepreneurial terms, it deals with making the best out of the undervalues, slack or discarded resources (Desa and Basu, 2013). It often helps social ventures to mitigate the constraint of resource constraints, by enabling the creation of new and pioneering products for the community (Philips and Tracey, 2007; Di Domenico, Haugh and Tracey, 2010). Thus, the inherent characteristics of bricolage are to enable a process driven solution, qualifying it as a 'design philosophy' (Louridas, 1999; Desa and Basu, 2013). Louridas, (1999) stated that bricolage is a state of unselfconscious design, where the need of the process itself defines the outcome of the design. For example: 'In our traditional society, artefacts are usually manufactured and designed by their prospective users. Houses are designed and built by their inhabitants, and not by architects'(Louridas, 1999). Thus, designing a social process through bricolage has a direct impact. Its response to problems is immediate, where the embodied material in the process is taken directly from the surroundings, and the designer is adaptive in response to the problems (Louridas, 1999).

In this study, this philosophy of anthropology meets design is expanded in the form of a village Resource Symbiosis Model (RSM), where the available resources in the village are utilized symbiotically for inclusive development. RSM is an extension of social entrepreneurship, where the producers and consumers have feedback loops in the form of mutual benefits, which integrates into a sustainable market-based resource consumption model. Here, RSM leverages self-sustenance and wealth creation through a market-based economy. One successful example of bricolage is the development of Grameen Bank microfinance projects by Dr. Mohammed Yunus in Bangladesh. Bricolage helped Grameen Bank to appeal to the needs of the poor, where the institutional banks refused to extend credit to the poor. As this banking model continued to grow and demonstrate high repayment rates from its risk-taking clients, the idiosyncrasy around the creditworthiness of the poor was slowly transformed into an attractive financing opportunity for

commercial banks (Bornstein, 1996). Similarly, RSM intends to raise the optimal resource utilization of the village, which will enable economic upliftment from the bottom-up, unlike the current system of trickle-down development approach (Breitkreuz *et al.*, 2016).

The novelty of this study lies in the conceptualisation of a fit-for-purpose resource symbiosis model (RSM) by leveraging the concept of bricolage. The RSM expands as a co-management model for a rural community in resource-constrained environments to manage their resources efficiently in collaboration with local governments, an aspect that has been much overlooked in the previous literature. This fit-for-purpose model is derived through a participatory-approach that caters to the specific need of a village concerning its socio-cultural and economic needs. An RSM model can foster sustainable livelihood generation in rural areas by creating economic self-sufficiency and establishing a market-based economic (wealth) generation system. Thus, making it a co-management model for typical trickle-down government rural development projects. This reduces the absolute dependency on the trickle-down government funds and broadens the scope of private investments with higher returns. It fit-for-purpose quotient of RSM makes it an ideal add-on to the current rural development schemes of the government like the National Rural Livelihood Mission (NRLM) and the Integrated Rural Development Plan (IRDP) of the Ministry of Rural Development (MoRD). This study creates a structured goal-oriented livelihood generation framework for the study village which can foster an entrepreneurial ecosystem in the village. It also contributes to the lack of literature on sustainable livelihood generation methodologies for rural development in India. Additionally, the fit-for-purpose process of RSM conceptualisation can be replicated to any rural development projects around the world.

The paper is divided into following sections: Section 2 sets the conceptual basis for a resource symbiosis model (RSM) through bricolage. Section 3 discusses the mixed-method research methodology used in this study, and the representation of the village built environment and the current entrepreneurial ecosystem. This section also provides the descriptive statistics of the village related to its current demographics and infrastructure and creates the foundational basis for the application of bricolage. Section 4 deal with the methods of problem identification and resource mapping for the estimation of RSM. Section 5 deals with

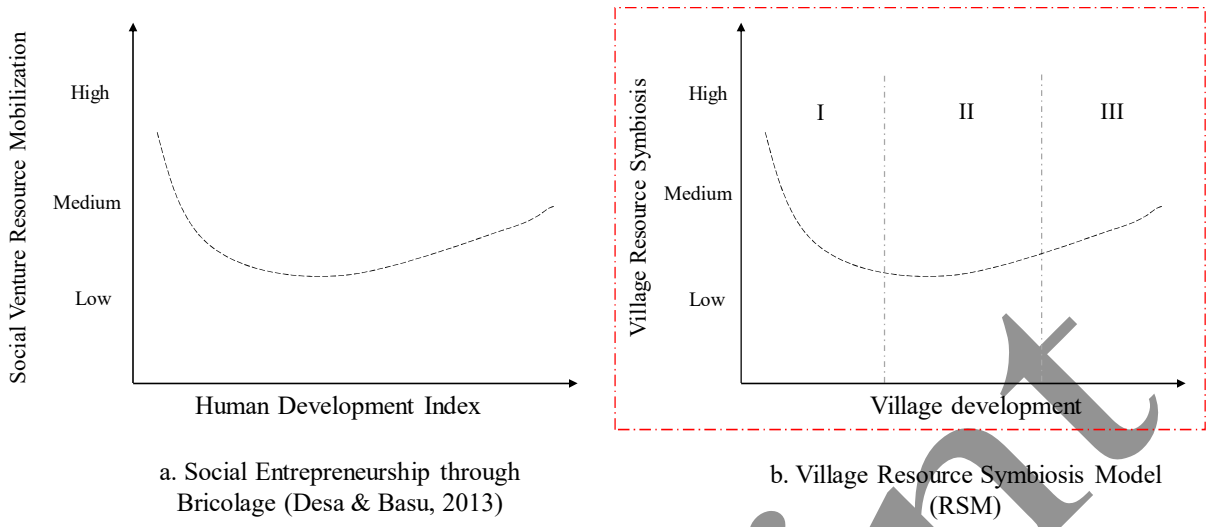
177 the development of RSM and provides a proof-of-concept for the study area, and the conclusion is drawn
178 in Section 6.

179 2. Conceptual framework

180 Here, the notion of bricolage is extended to form the conceptual foundation of Resource Symbiosis Model
181 (RSM), which implies *'the best use of resources available in hand'*(Louridas, 1999; Baker and Nelson,
182 2011). RSM is an application of bricolage of resources to rural areas. The subject of this study is a rural
183 area in western India (see Section 3.1), where the MoRD wants to mobilise resources for capacity building.
184 Capacity building through self-sufficiency and wealth generation can be a crucial bricolage model for its
185 livelihood sustainability. Thus, signifying the importance of resource bricolage as an *active developmental*
186 *tool*.

187 Here, to lay down the framework for RSM, in-depth village resource and household surveys were conducted
188 from the perspective of people, places, and practices. These surveys helped in understanding the organic
189 fabric of the village that regulate its life cycle. Personal interview of the local entrepreneurs and shopkeepers
190 also formed a critical element of the RSM design process. This study converges by forwarding the basic
191 framework of RSM, however, proving this model is beyond the scope of this study. It lays down avenues
192 for future research on RSM as a tool for leveraging *village start-ups* in developing countries.

193 The conceptual framework of facilitating village development through resource mobilisation through
194 bricolage is illustrated in Fig. 1. This concept is an extension of the empirical findings of Desa & Basu,
195 (2013), which indicated a U-shaped curve of social resource mobilisation and improvement in Human
196 Development Index (HDI) (see Fig 1).



a. Social Entrepreneurship through Bricolage (Desa & Basu, 2013)

b. Village Resource Symbiosis Model (RSM)

197

198 **Fig. 1 Conceptual framework for village Resource Symbiosis Model (RSM).**

199 Fig. 1b illustrates the conceptual framework of the village RSM, where it is divided into three parts. Phase
200 I implies that at the initial phases high level of resource mobilisation and significant bricolage will be
201 required to push village development, i.e. more resources must be mobilised to create a balance between
202 self-sufficiency and wealth creation from market-based businesses. The Phase-I of the model (see Fig. 1b),
203 essentially assimilates the social and natural resource elements of the village to create this balance. Once,
204 the balance is established, the process of symbiosis begins. It marks the Phase-II of RSM, where the virtue
205 of the symbiosis drives development. This stage can act as a dock for the implementation of MoRD schemes
206 for rural development (see Table 1).

207 The third phase (Phase-III) will be the advanced phase of RSM, where resource utilisation will directly co-
208 benefit the advanced growth of the village, i.e. at this stage resource mobilisation in the village to impact
209 the quality of life directly. Thus, the village development will imitate *city-like* growth curve. At this stage,
210 it becomes highly probable that the village can be promoted to an Urban Local Body (ULB) (P.K.Chaubey,
211 2003; Bhagat, 2005). However, the ideation of Phase-III is kept open-ended and is beyond the scope of this
212 study.

213

3. Data and Methodology

This study deploys a mixed-mode research method (Morse, 2003) for cross-sectional analysis of the village resources. Field surveys were conducted in the summer months of May-July 2015, which included qualitative and quantitative data collections through household surveys, personal interviews and participatory rural appraisal (PRA) techniques (Chambers, 1994). PRA was done to enable local people to share, enhance and analyse their knowledge of life and conditions. It included village resource mapping and modelling, transect walks in the North-South and the East-West directions, the problem ranking of the village, seasonality diagrams and the daily time-use pattern of men and women of the village.

A mixed-method research design was used in this study, to maintain congruence with the design philosophy of bricolage, such that critical insights were derived from both qualitative and quantitative methods for RSM formulation. This research design was employed to address the multi-dimensional need of social-entrepreneurship using bricolage. Secondary data sources included data from the Population Census of India, 2011 (Census, 2011) and data sourced from the local government office of the *Gram Panchayat* (Local governing body) and *Talathi* (Village Accountant) records. Seventy-five households were selected based on the sampling method of stratified random sampling (Marshall, 1996), such that the socio-economic structure of the village was significantly reported in the survey samples (discussed in details in Section 3.1).

3.1 Study Area

The village of Singnapur (19°10’21 N, 76°44’28 S) is situated 15 km from the Parbhani-town, in Parbhani district on the Gangakhed-Parli main road (see Fig 2). It is approximately 3 km interior from the main road. The local-governance body consists of a village council with an elected head known as ‘Sarpanch’. The nearest towns include Parbhani (15 km) and Jaithna (18 km). This village is in the central part of the state of Maharashtra, India. The gram-panchayat consisted of 11 members, out of which 5 were women. There were 13 SHGs, and the economy was agriculture driven. The total geographical area of the village is approximately 1756 hectares (ha). The village receives an annual average precipitation of 996.4 mm, and

238 the average number of rainy days in a year is 48.6 days. The average solar irradiance is 5.5 kWh/m^2/day
239 (MNRE, 2017). The average annual temperature is 21.2°C, with an average daytime summer temperature
240 of 49°C (May-July). The total cultivable area is 1599 ha and the major crops cultivated were cotton,
241 sugarcane, wheat, and soybean. This area is highly prone to draught causing the high intensity of water
242 stress in the region. The soil type is predominantly black cotton soil. There is three dominant religion in the
243 village, Hindus constitutes 72.35% of the village's population, Muslims and Buddhists constitute 16.69%
244 and 10.23%, respectively of total population (Census, 2011).

245 Roads and rails connect Singnapur. The village transportation system consisted of State-run buses (3 times
246 a day), passenger trains (4 times a day) and privately owned three-wheeled vehicles called *tum-tums* (almost
247 50 in number). The village is known for its premium quality vegetable produce, making it the largest
248 vegetable supplier for the Parbhani town. The literacy rate was 58%, which was lower than the national
249 average of 66% (Census, 2011).

250

251 **Fig. 2. The village boundary of Singhnapur, Maharashtra, India.**
252 **(Source: https://www.google.co.in/maps/@19.1738724,76.735659,1296m/data=!3m1!1e3)**

3.1.1 Population Demography

The total population of the village as per 2011 records was 5,016 with a population density of 285/km^2 (Census, 2011). The village has a paternalistic societal structure, despite a 49% female constituency in the total population of the village, as per the 2011 Census (see Table 2). The decadal growth rate (DGR) of the population was found to be around 12%, while the annual growth rate (AGR) was computed to be around 1.1%. During the time of the survey in 2015, the total number of households was 920 (the Census of 2011 data records 906 households, see Table 2).

Table 2 Vital population statistics and population estimation (Source: Census, 2001 and 2011)

Parameter	Year 2001	Year 2011	DGR (%)	AGR (%)	Estimate (Year 2021)
Population	4478	5016	12.0	1.1	5618
Total Male Population	2213	2555	15.5	1.4	2862
Total Female Population	2185	2461	12.6	1.2	2756
Total Households	837	906	8.20	0.8	1015
Total SC Population	260	360	38.5	3.3	403
Male SC Population	160	182	13.8	1.3	204
Female SC Population	100	178	78.0	5.9	1999
Total ST Population	8	14	75.0	5.8	16
ST Male Population	2	6	200.0	11.6	7
ST Female Population	0	8	33.3	2.9	9

(where, SC = Scheduled Caste; ST = Scheduled Tribe.)

In 2014, the number of live births was 106 the death count was reported to be 12. Most of the deaths were due to old age. Proximity to the city, improved awareness and adequate medical facilities in the nearest town (Parbhani) played a significant role in determining the health conditions of the village. The close accessibility to private clinics in the town leveraged their access to better healthcare. The academic performance of the village was better during 2014-15. Eighty-one percent students have passed Senior Secondary Certificate Examination (SSC) in this year, and 585 students had completed their primary schooling (Grade 1-5). There had been some encounters with graduate engineers, science and commerce graduates, chartered accountants and a doctoral student from the village, which subjectively signified the

educational progress of the village. There were five blind, nine deaf and four mentally challenged persons registered in the village. 152 households in the village fall under the Below Poverty Line (BPL) category (yellow-card), while 345 households are registered as the Above Poverty Line (APL) (saffron-card), 108 households were in the poorest of the poor or the 'Antyodaya Anna Yojana' category (AAY). Hindus, Muslims, and Buddhists co-existed with demarcation in the existing boundary. The *Patils* (an ethnic group of Hindus) are the wealthy landlords. Despite the religious, cultural and economic diversity, the village has been in harmony and won several awards for fostering long-term communal harmony in the region. Fig 3 shows the status of gender inequality in the village (computed based on the Census, (2011) data).

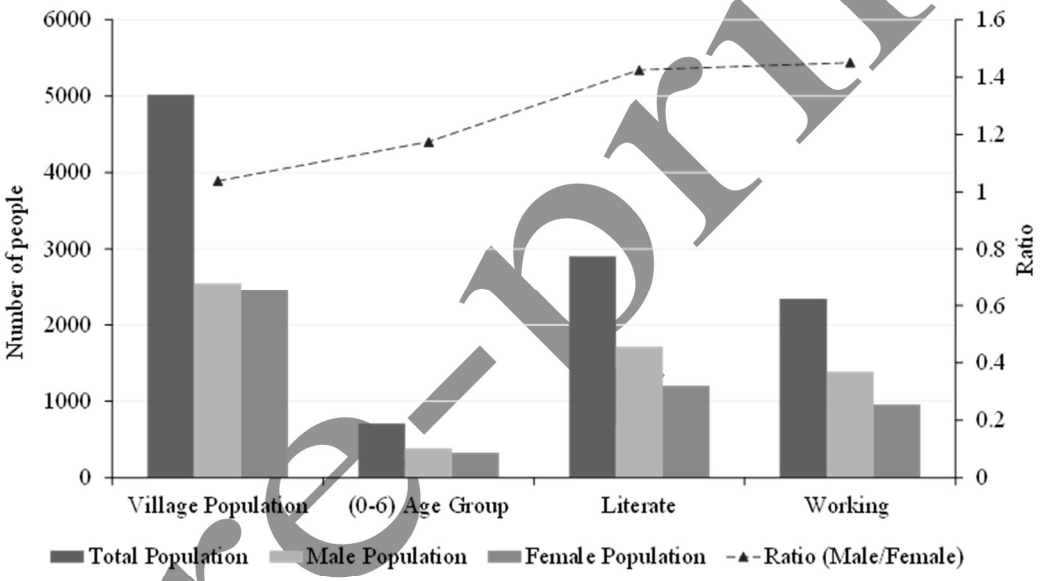


Fig. 3 Male and Female ratio comparison of the village. (Source: Census, 2011)

The population pyramid illustrated in Fig 4, shows that the percentage of men in the age group of 25-29 is twice as higher as that of the female population in the same age group. Thus, this stratum of demography is at the highest propensity to migrate to urban areas in search of jobs and a better quality of life. However, if reliable livelihood option can be provided in the village, then such migrations can be prevented. Our survey revealed that this disparity in male-female population between the age of 25-29 was primarily due to sex-selective childbirth during the 1980s.

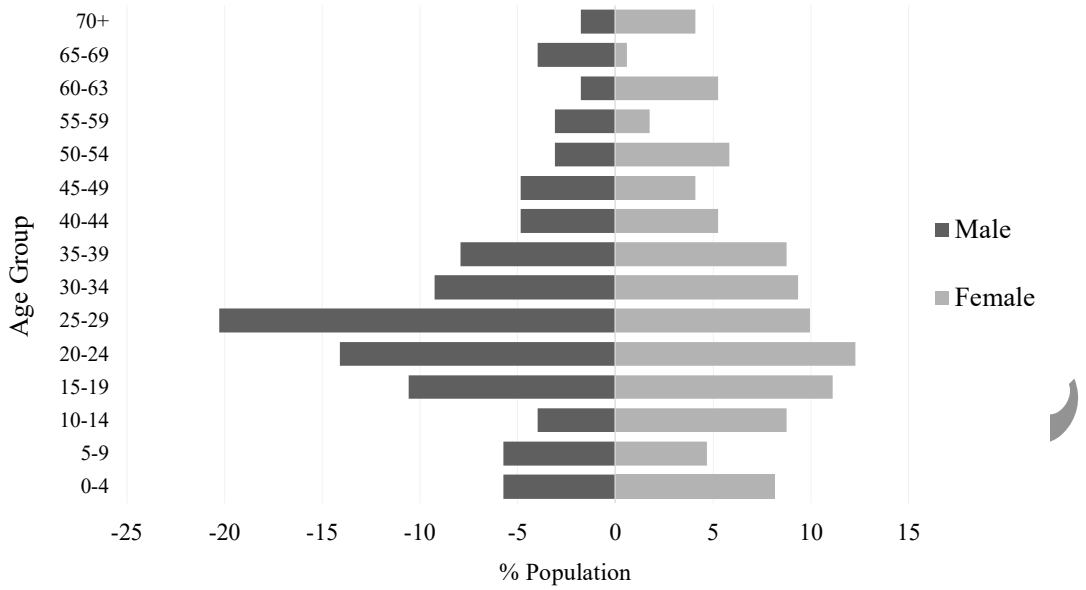


Fig. 4. Population pyramid of the village based on the household survey. (Source: Author's survey)

3.1.2 Built environment at a glance

The village had 920 households (HH) at the time of the survey, out of these 19 HH were female-headed. The construction of the houses was categorised into three typologies, namely, *kuccha*, *pucca* and *semi-pucca* (see Fig 5). Kuccha houses are referred to a traditional mud-walled house, whereas the pucca house is referred to brick wall construction. The semi-pucca is referred to as half-brick walled houses (Debnath, Bardhan and Banerjee, 2016, 2017).

Fig. 5 Housing typologies in the village. (Source: Author's survey)

The most common roof material for the kuccha and semi-pucca houses was an asbestos sheet or tin which gets blown away in windy situations. Securing the roof structure was a significant challenge for the

villagers. The domestic fuel for cooking was primarily firewood even though higher income group houses had liquefied petroleum gas (LPG) based cookstoves. The deposition of black carbon from burning firewood was a chronic problem of the households (see Section 4). Additionally, high level of indoor air pollution was familiar to every household. Fig. 6 illustrates the occupancy percentages of the housing typologies based on the religious groups in the village. It can be inferred that all the surveyed Muslim HH resided in kuccha houses.

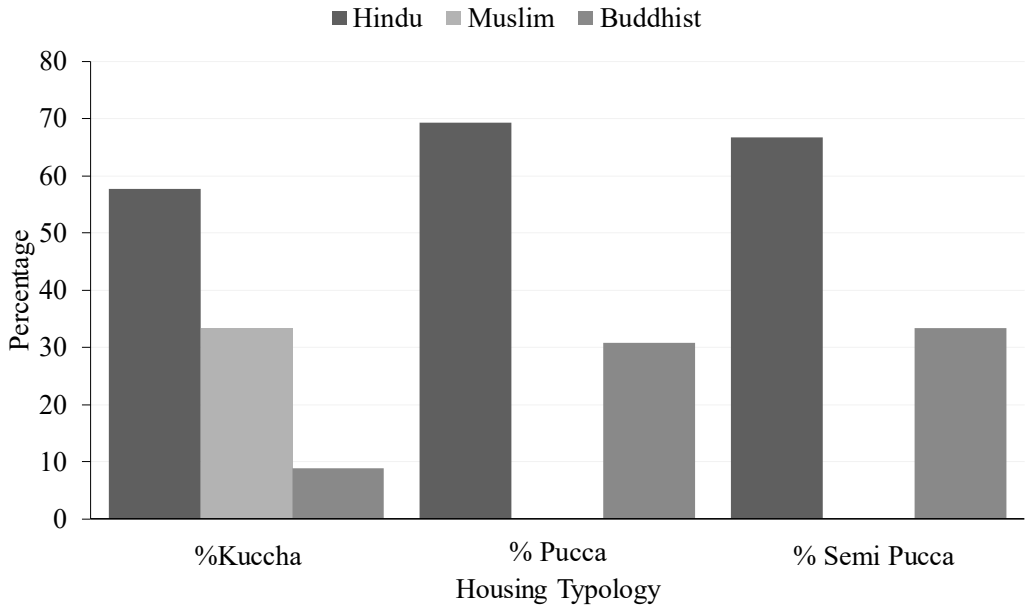


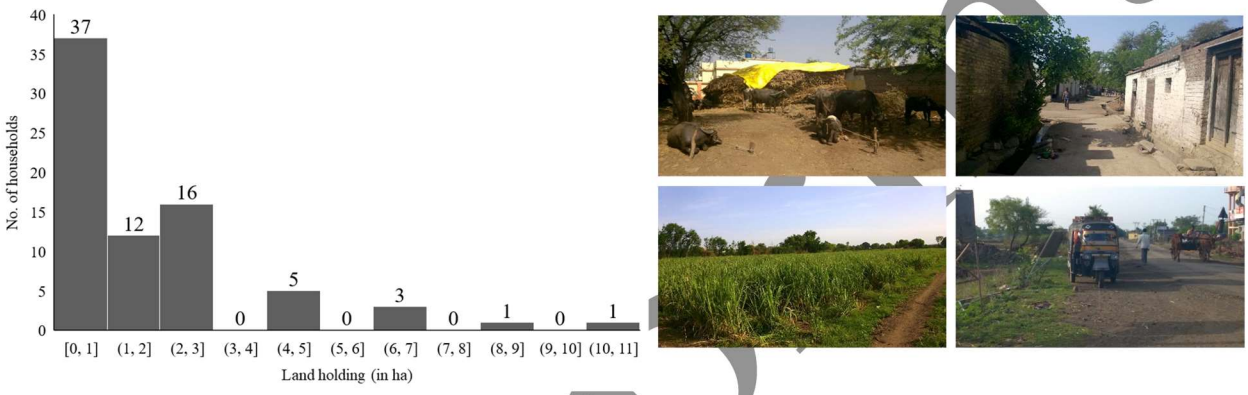
Fig. 6. Housing typologies and its occupancy based on religious groups in the village.

(Source: Author's survey)

It was found that 87% of the surveyed HH were electrified with metered connections. However, the remaining 13% were involved in electricity thefts using methods like illegal hooking of conductors in the neighbours' electric connections. The irregular billing periods and abnormal amount representation in the electricity bills add to the indefinite woes of the villagers. For example, in an HH survey, it was found that the electricity bill for three months came out to be Rs. 7000, which was more than their monthly HH income.

The per-capita land-holding distribution is illustrated in Fig.7a, which shows that almost 50% of the surveyed household owned small plots of land between 0-1 ha. The next 37% of the population owned between 1-3 ha of land, whereas the next 13% owned large tracts of land between 4-11 ha. Thus, the median

and median per-capita land-holding is estimated to be 1.01 and 1.56 ha, respectively. Concerning vehicle ownership, 77% of the surveyed HH owned a two-wheeler, whereas 11% owned four-wheelers. The ownership of a four-wheeler especially a car, was a symbol of status in the village. The remaining 12% owned tum-tums (see the previous section) and provided private transportation services to the villagers with a fare of Rs. 5/km. Fig. 7b provides a snapshot of the land-use pattern of the village.



a) Per-capita land holding (in ha) b) Land-use and built-environment of the village

Fig. 7. Snapshots of the built environment of the village.

3.1.3 Water and Sanitation

With low levels of annual rainfall and a 48-day monsoon cycle, water is a scarce resource in the village. Agriculture, being the primary occupation of the village, significantly adds to the water stress in the community. The primary source of HH water is through hand-pumps, on which 67% of the surveyed HH were dependent. Wells cater to the water needs of the rest 31%. The water infrastructure in the village includes 323 wells, 23 bore-wells and two elevated storage reservoirs (ESR) (75000 litres and 60000 litres capacity, respectively). A government-owned canal runs through the village, covering a net area of 395 ha. However, it remains dry for the most of the year, and the water availability is highly dependent on the water levels of the nearby check-dam.

Open defecation is widely practised, with over 75% of entire houses without toilets (Census, 2011). It was observed that the lack of toilets was not a result of economic distress but was associated with deeper attitudinal and cultural issue. Open drains run through every household (see Fig 8) where all the wastewater from the households flows openly outside, and this leaves an unpleasant trail of odour throughout the village.

Fig. 8. ESR, open drains and a community hand-pump in the village.

The village had a 'water committee', that looked after the repair and maintenance (R&M) of the ESRs. There are two 7.45 kilowatts (kW) (or 10 horsepower (hp)) pumps for the ESRs and a 12-metre pipeline. This committee is also responsible for the R&M of the distribution transformers in the village. More than 55% of irrigation is done through groundwater, while the canal irrigates 23% of the land and the rest 22% is purely rainfed. Some of the water conservations measures at the village level were the construction of bunds and ponds. However, even after intensive water conservation measures, there was a deficit of about 370 tonnes per cubic metre (TCM) (or 370000 kg/m3) of water for agriculture (where tonnes refer to crop mass and cubic meter to water requirement).

3.1.4 Income and Livelihood

Agriculture is the most significant employer in the village. Based on the HH survey results 72% of the households were involved in agriculture, followed by tum-tum driver (8%) and agricultural labourers (7%). Fig. 9 illustrates the livelihood options in the village. The agricultural produce was sold-off to the local markets, depending on the perishability of the product. There were around 13 families in the village having

large quantities of dairy animals. The cattle population was around 1310. There were fabrication shops, carpentry shops, registered medical practitioners, pharmacists, 40 retail shops and three public distribution systems (PDS) shops. Based on the HH survey results, the average income was highest for the Hindus. The wealthy farmers usually earn profits of Rs. 5 lakhs per annum (approx. 7500 USD per annum), with an average land holding of 10 acres. However, the respondents were reluctant in disclosing the exact income figures.

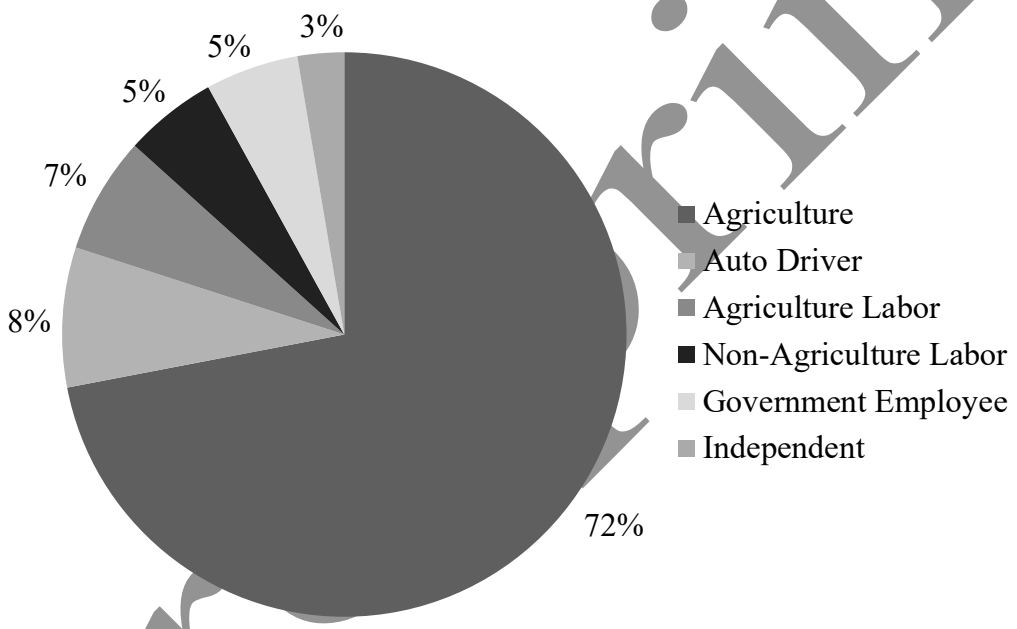


Fig. 9. Livelihood options of the village based on the survey results.

Based on HH surveys, an attempt was made to construct the income Gini coefficient (Yitzhaki, 1979), to understand the economic disparity of the village. The Lorenz curve (Dagun, 1980) is illustrated in Fig. 10, the Gini coefficient was calculated to be around 0.476. The Gini coefficient ranges between 0 and 1, where 0 represents perfect equality, where everyone has the same level of income, and 1 corresponds to perfect inequality, where one person has all the income, and everyone has a zero income (Yitzhaki, 1979).

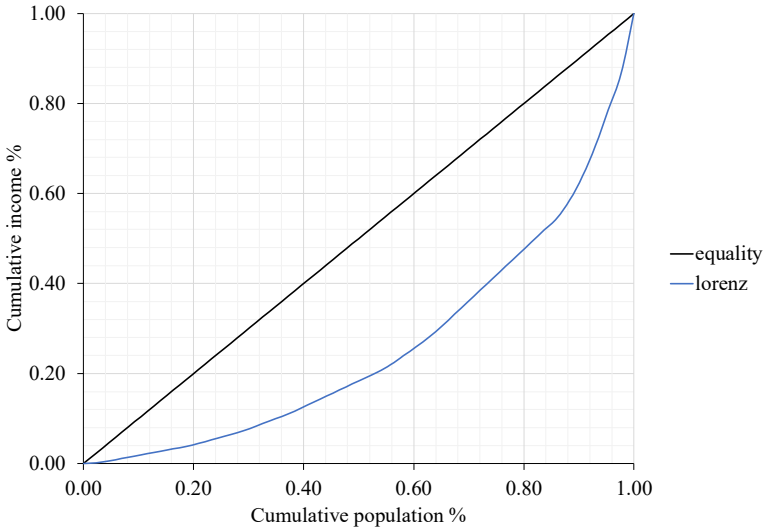
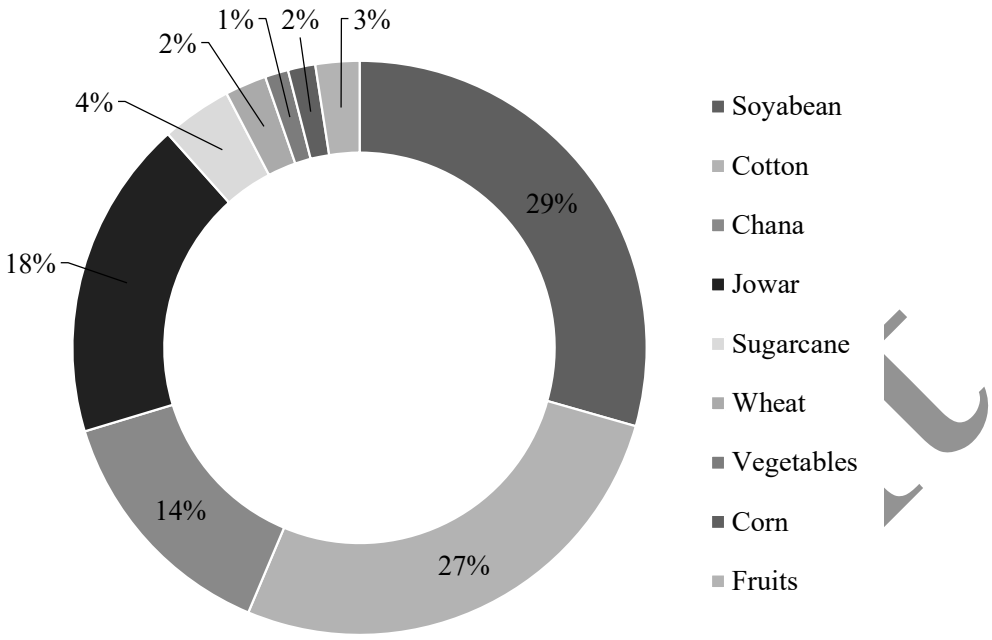


Fig. 10. Lorenz curve denoting economic disparity in the village (Based on the HH survey Data).

3.1.5 Agriculture and Land-use

The total area of the village was 1756 hectare (ha), out of which 1613.2 ha was the cultivable area, and 1580 ha was used for cultivation. The total water requirement for crops was 1225 tonnes per cubic meter (TCM). The primary food crops taken in the village to their cultivated area is represented in Fig. 11, out of which chana (bengal gram), wheat, jowar, vegetables, corn, soybean, and fruits were food crops, and, sugarcane and cotton were the major cash crops cultivated in the village. The two most important crops in the village cultivated during the Indian cropping season (Ravi and Kharif) are soybean and jowar (a variety of sorghum). Soybean is cultivated on 667 ha of land whereas jowar is cultivated on 410 ha of land. Cotton and sugarcane are cultivated on 611 ha and 90 ha, respectively. The cropping density of the village was 146.34%. Fig. 12 illustrates the water requirement of the major crops grown in the village, which shows that crops like soybean, cotton, and chana (bengal gram) contribute to more than 55% of the agricultural water demand.



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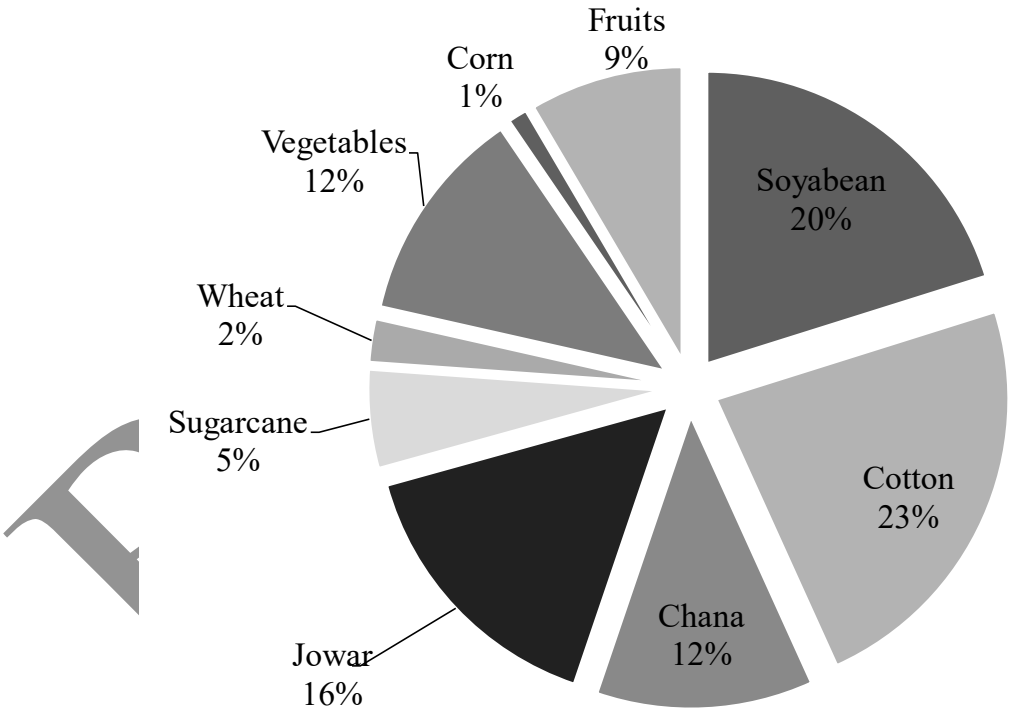
387 **Fig. 11 Major crops cultivated in the village in terms of the area (in ha). (Source: Author's Survey)**



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389 **Fig. 12. Water requirement of the major crops (in percentage) cultivated in village.**

390 **(Source: Author's Survey)**

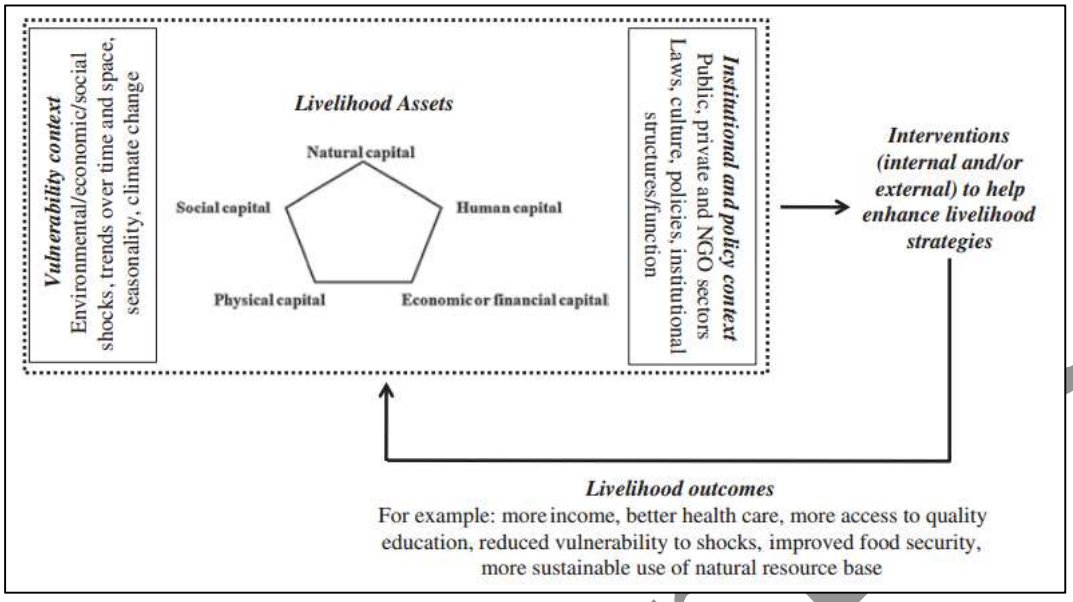
391

3.1.6 Entrepreneurial Activities in the Village

Singnapur had been entrepreneurial with about 40 retail shops in the village including three PDS (public distribution shops), four welding and carpentry shops, one pharmacy, mobile recharge and tailoring shop, respectively. There was no formal dairy industry in the village but had a large cattle population of about 1000. The village had a state-owned rural bank, and 13 unorganised micro-finance institutes in the form of Self-Help Group (SHG). The penetration of mobile phones (mostly smartphones) was very high. There was at least one smartphone per household (based on household (HH) survey). There was a village 'WhatsApp (an instant messaging smartphone application) group' (WhatsApp Inc., 2018) that made information dissemination accessible and affordable. This virtual group was widely used in sharing information on crop produce, market timing, fertiliser scheduling and community-events like religious-text reading events, cultural nights. The proximity of the nearest town Parbhani, as discussed earlier, provided an opportunity for the farmers to sell their fresh produce, and maintain a healthy supply chain. The population distribution is shown in Fig.4, indicating the presence of a large cohort of young workers in the village. Engaging this cohort with activities of their skillset and generating economic returns can be looked at as a potential thrust area of bricolage and thus, they form the most significant resource of the RSM framework (see section 1 and 2).

The village had the necessary level of infrastructure to sustain itself, which ease up the resource mobilisation for bricolage, providing an original impetus to a probable resource symbiosis. Thus, the transition between Phase I and Phase II of the RSM conceptual framework (see Fig 1) becomes relatively easy. The bricolage evaluation was carried out using the Sustainable Livelihood Framework (see Box 1) by S. Morse and McNamara, (2013), where they mention five pillars of sustainable rural livelihood, namely, natural capital, human capital, economic or financial capital, physical capital and social capital.

414 **Box 1. Sustainable Rural Livelihood Framework. (Source:** (Morse and McNamara, 2013)**)**



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416

417 ***Successful entrepreneurial activities in the village: Case studies***

418 This section provides case studies of the successful entrepreneurial activities in the village. These case
419 studies would help in understanding the entrepreneurial temperament in the village, which will provide
420 critical inputs for the proposed RSM. Welding and fabrication shops, an amla (Indian Gooseberry)
421 processing unit, a milk processing owner and small retail shops constitute the entrepreneurial ecosystem of
422 the village (see Fig. 13). To maintain anonymity, pseudonyms in the form of initials of the
423 entrepreneur/interviewee were used in place of their actual names.

a. Welding Shop b. Milk Processing Unit

c. Street vendors d. Fabrication shop

Fig. 13. A few businesses in the village.

Case Study: Amla (Indian Gooseberry) Processing

Amla (Indian Gooseberry) processing was a niche entrepreneurship for GK, who had been trying to explore and establish this business in the village. He started his business two years ago on his 3.23 ha of farmland, and with a graduate degree in commerce. During the initial phase of his business, amla cultivation was done for town markets, and his selling price was utterly market-driven. Soon, he began to internalise the value addition in amla farming, through selling processed products like amla candies, syrup, juice, pickles and dried morsels of this fruit. Being the niche seller of processed amla in the village, he could hold a more significant share of the market through self-branding and labelling of his products. However, due to lack of storage facilities, the raw fruits cannot be kept fresh for longer duration which is a significant bottleneck to his business. GK owns 0.4 ha of farmland and plants around 800-850 trees annually. The plants need to be watered for four initial months through groundwater and then irritated with rainwater in the monsoon. It is harvested in September, soon partly sold to the town-markets and later sold to the more prominent city

markets. The processed amla products are sold in weekly markets, with sales maximisation occur during the festive seasons, farming and sale exhibitions. Table. 3 illustrates GK's amla products. Fig. 14 represents the amla processing business of GK in the village.

Table 3. Details of production, operations and logistic related costs of amla (Indian Gooseberry) processing

Parameter	Specification	Details
Logistics	Transportation cost (other states)	Rs. 40 per 100 kg
	Fruit plucking charges	Rs. 50 per 100 kg
	Selling price in other states	Rs. 50-60 per kg
	Selling price in Parbhani	Rs. 20 per kg
Investment	Electric drier (used)	Rs. 25000
	Sealing machine	Rs. 1700
	Labelling	Rs. 1.85
Operational Cost (Packing)	Plastic for candy	Rs. 0.28
	Plastic for making pouch	Rs. 4
	Plastic container	Rs. 6 (inclusive of labeling)
Packing Details	Candy	200 g, 500 g, 700 g and 1 kg
	Crush	500 g
	Pickles	500 g
	Jelly	500 g
Costing (CP and SP per kg)	Candy	CP: Rs 80; SP: Rs 200
	Crush	CP: Rs 50; SP: Rs 160
	Pickles	CP: Rs 90; SP: Rs 200
Raw Material	Candy	100 kg Amla, 100 kg sugar, 2 kg alum
	Pickles	18 % salt, 4 % turmeric, pulses and oil
Raw Material Production	Amla Production	30000 kg
	Amla Processing	1500-3000 kg

[Note: CP = Cost Price; SP = Selling Price. The data is collected through unstructured personal interviews, as a part of this study's field survey methodology].

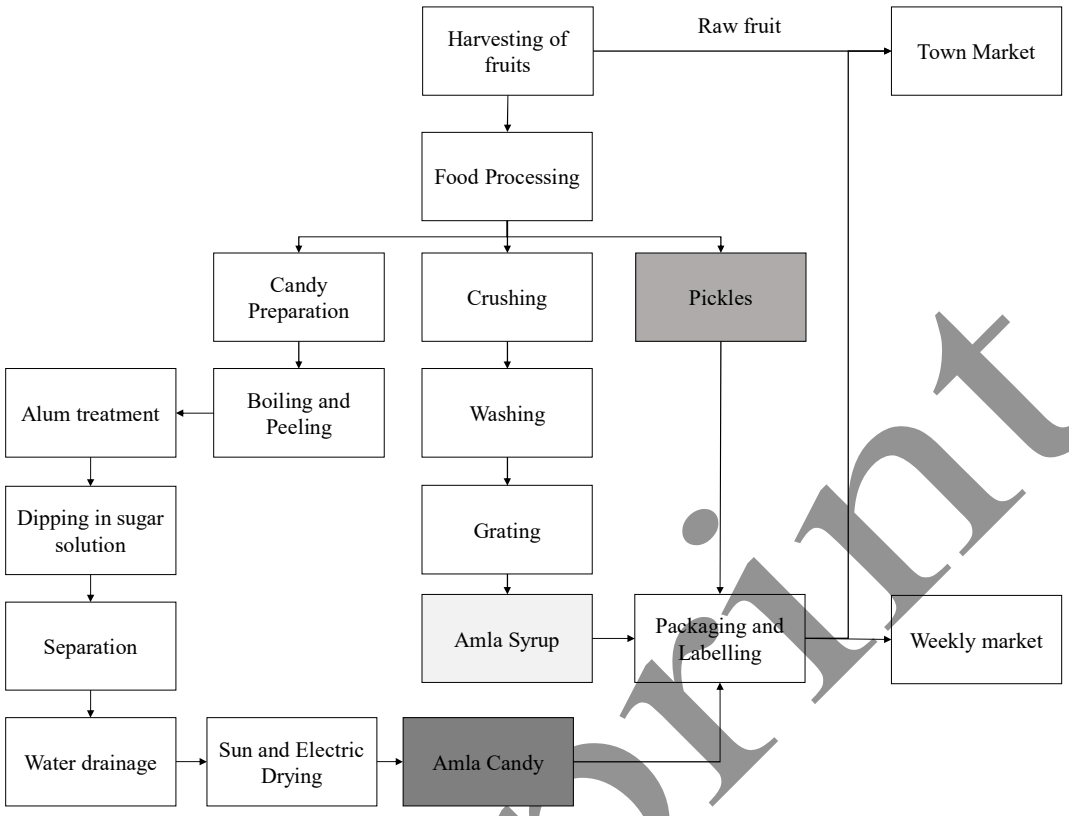


Fig. 14. Process flow of Amla (Indian Gooseberry) Processing Business in the village.

(Source: Author's survey)

Case Study: Milk Processing Unit in the village

A micro-scale milk processing unit was set up by SK, who also owns a fertiliser shop in the village. He is quite an entrepreneurial man, with a land holding of 8.1 ha, and five milk-producing buffaloes. These animals produce 25 litres of milk per day, of which he sells 15 litres of pure organic milk, and the remaining 10 litres is used for producing milk products such as curd and ghee (India clarified butter). His business expansion plan includes the production of milk-based desserts, including ice-cream and cream cheese. However, lack of a cold-storage facility in the village is creating a bottleneck for his expansion plans. Moreover, lack of proper animal sheds affects their health, which in turn affect the quality of milk. He strongly feels that the government needs to promote animal husbandry activities like dairy industry and the supporting infrastructure. He agreed that given a chance to work full time, he would opt for dairy in

458 comparison to the other two activities (selling fertilisers and farming) presently being carried out by him.
459 Table. 4 represents the statistics on the milk production unit of SK.

460 **Table 4. Statistics of Milk Processing in the village. (Source: Author's Survey)**

Parameter	Specification	Details
Animal Statistics	Cows (milking)	0
	Buffalo (milking)	5
	Calves	22
	Milk (per day basis)	25 litres
Production	Curd	5 litres
	Ghee (clarified butter)	5 litres
	Raw milk sold	15 litres
Inventory	Cow shed	103 m^2
	Ghee making vessel (10 litre)	Rs. 1250
	Animal Food (daily basis)	60 per animal
	Electricity (monthly)	300 (fans and refrigeration)
	Water (daily drinking)	35 litres/ animal
Operational Costs (in Rs)	Labourers (2)	10000 per month
	Medication (animals)	500
	Transportation	40
Products	Milk Selling Price	Rs. 40-60 per litre;
	Range of selling	Rs.4/100 ml; Rs. 20/ 500 ml
	Curd	Rs. 40 per litre
	Ghee	Rs. 600 per kg (10 litres of whole milk yield about 1 kg ghee)

461

462 ***Case Study: Automatized-farming practices***

463 ES is a farmer of the village who primarily cultivates and markets pomegranates. His business yields the
464 highest revenue in the village. He had mechanised his irrigation and farming system in his 17-ha land. He
465 is regarded as the most entrepreneurial man of the village of his extensive landholding, shares in sugar mill
466 and contemporary farming methods (see Fig. 15). He was the chairman of a sugar mill in the village. He is
467 trained as an agricultural engineer and believes in adapting to contemporary farming practices through
468 large-scale agricultural investments. His education background, entrepreneurial skills and liberal views to

new ideas makes him a role model for the village. He envisages opening a 'Farmer's Mall' in the village, which can attract private investments to establish an agro-tourism industry in the area eventually. His immediate plan includes establishing an oil mill, packaging, and labelling unit for his farm produce and an organic farming shop in the village. He believes these establishments would provide the required impetus to attract investments for the farmer's mall. He wants to improve the quality of life of the people in the village, through optimal local resource utilisation and mobilisation through modern techniques. We found that his development philosophy resonated with our concept of RSM and we had extended brainstorming session on the development of RSM for the village.

a. Water harvesting

b. Automatic irrigation and fertilizer dispenser system

c. Mulching process

d. Drip irrigation system

Fig. 15. Intensive mechanised farming in the village by farmer *ES*. (Source: Author's survey)

4. Resource mapping and problem identification

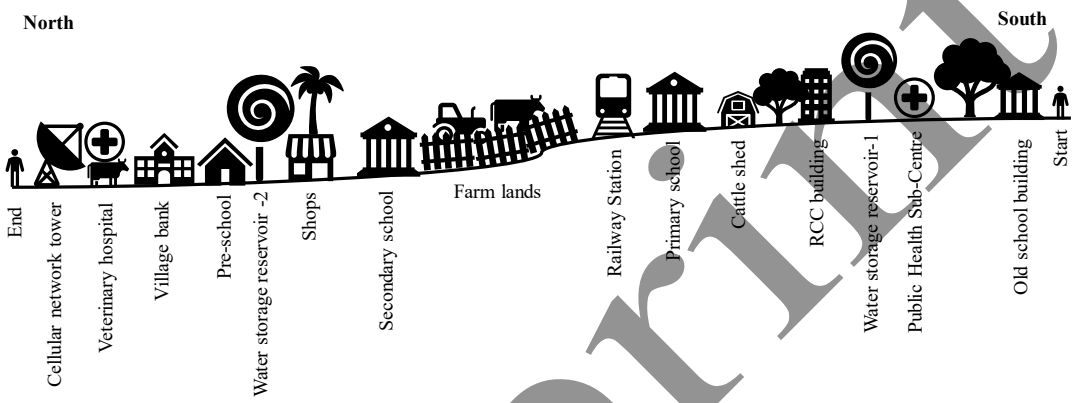
The mixed-mode research method adopted in this study was instrumental in understanding the socio-economic fabric of the village with PRA, with personal interviews being the principle method of investigation. The PRA activities helped in gaining meaningful insight of the processes of the village so that a process-driven solution can be designed using the concept of bricolage (See Section 1 and 2). In this purview, unstructured interviews, and resource mapping were carried out using PRA. Adult males and females were separately interviewed to understand their problems and drudgery, which are often kept beyond the scope of government reports. It impacts the effectiveness of the rural development policies.

The concept of bricolage was operationalised through a three-step process: the first step, included village asset identification using HH surveys and unstructured interviews (see Section 3.1), the second step included resource mapping and problem identification through PRA (see Fig 16), and the third step includes the development of the village's Resource Symbiosis Model (RSM) through the assessment of their livelihood options usingStephen Morse and McNamara 's (2013) sustainability livelihood assessment framework (see Box1).

Fig. 16. Problem identification and resource mapping in the village using PRA techniques.

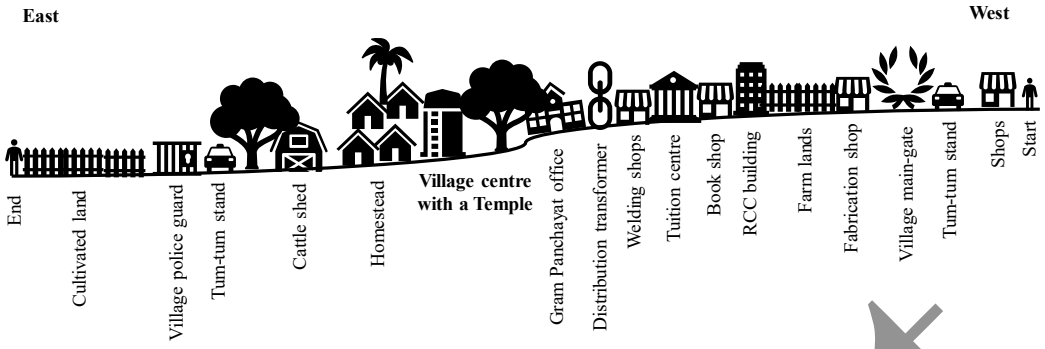
(Source: Author's survey)

Transect walks were carried out in the North-South (see Fig.17) and East-West (see Fig.18) directions to record the critical resources regarding land-use pattern, public infrastructures, soil type and problems. The village social and resource map (see Fig.19) was also created as a part of the PRA exercise. These maps provided critical input to the livelihood assessment framework for leveraging RSM through bricolage (as will be presented later in Table 5).



Land Use	Roads, homestead, veterinary ground, playground, bank parking, shopping area	Crop-field, open defecation ground	Railway tracks, school playground	Roads, homestead, playground, cattle grazing area
Soil	Cemented roads and partly red-soil	Black soil	Railway tracks and gravels	Mud roads (clay soil)
Crops	None	Soybean and cotton	None	None
Livestock	Cows, buffaloes, goats, chicken	Bull, buffaloes	None	Cows, buffaloes, goats, chicken, ducks
Problems	Broken roads, lack of toilets in schools, open drains	Open defecation, water scarcity	Lack of land-use knowledge	Open drains, lack of toilets, broken roads
Recommendations	Initiation of road repair through Pradhan Mantri Gram Sadak Yojana (PMGSY) scheme, school toilets construction through SHGs, regular cleaning of open drains	Suitable site for community toilets, construction of rainwater harvesting units	Land-use planning, upgradation of the railway station	Proper roads for easy access to the health centre, suitable site for community biogas plant

Fig. 17. North-South transect walk.



Land Use	Farm land, tum-tum stand, cattle grazing grounds	Community center, temple, community handpump	Cemented roads, Village Chief's Office	Roads, railway crossing, shopping area, tumtum stand, small patches of farmlands, tuition centre
Soil	Black soil, red-brown Soil, patches of cemented grounds	Cemented grounds	Cemented grounds	Partly red soil, cemented roads and railway tracks
Crops	Soybean, sugarcane, cotton, chana (bengal grams), vegetables, jowar, pulses	None	None	Vegetables, cotton and sugarcane
Livestock	Cows, buffaloes, goats, chicken, bull	Cows and goats	Chicken, goats	Cows, buffaloes, goats, bull
Problems	Open defecation, water scarcity	Open drains, water scarcity, water logging during rains	Open drains, lack of toilets in the HHs.	Open drains, open defecation
Recommendations	Intercropping, optimal location for dairy plant, watershed management	Covering of open drains, water management	Construction of toilets	Suitable location for community toilet

Fig. 18. East-West transect walk

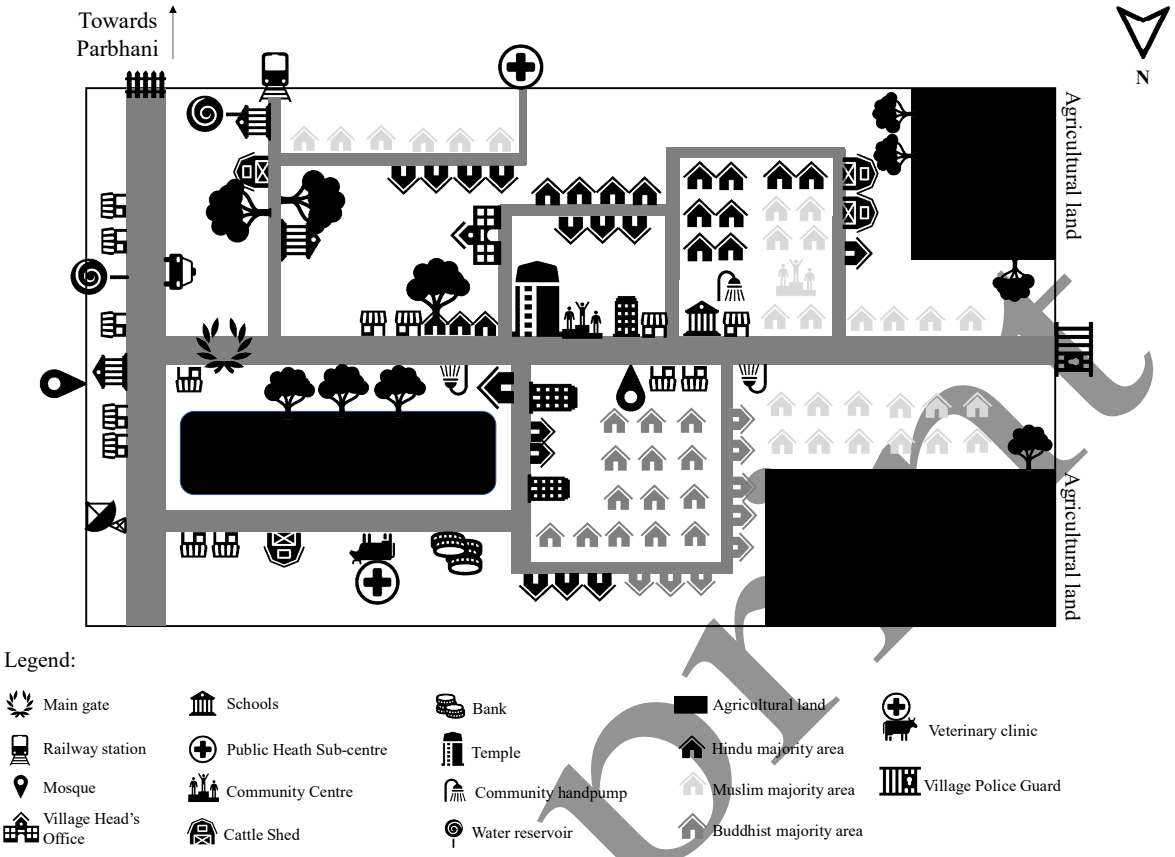


Fig. 19. Author's rendering of the social and resource map of the village, based on PRA activities.

Problem identification and its ranking were also carried out as a part of PRA activity, where both men and women were asked separately to rank the prevalent problems in the village. The weights were given out of 15, i.e. the most problematic entity received a score of 15, whereas the least concerned problem was scored as 1. Fig. 20 illustrates people's view of the common problems of the village, where the *y-axis* lists the widespread problems, and the *x-axis* shows the gender-based scores for each problem. This step was essential to cumulatively understand the scope of bricolage so that appropriate planning for the Resource Symbiosis Model (RSM) can be established.

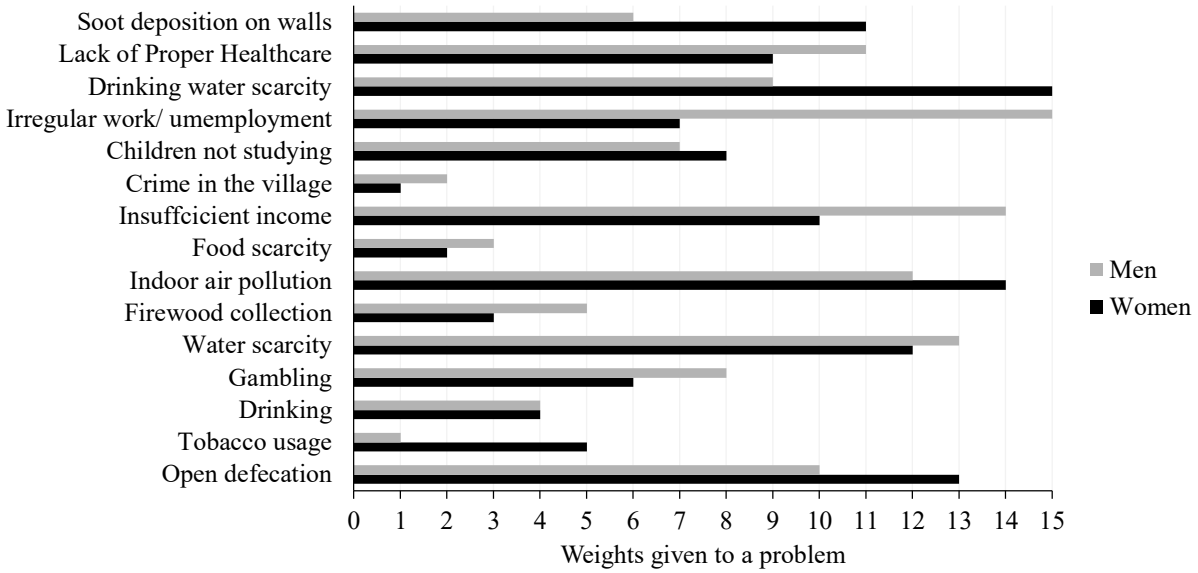


Fig. 20. Problem identification and ranking in the village. (Source: Authors' survey)

The next step was the assessment of these ranked problems for the sustainable rural livelihood assessment framework (Box 1) so that the critical variables for the RSM could be identified. Table. 5 illustrates the critical results of the livelihood assessment framework based on the field surveys and personal interviews through PRA. Thus, the variables identified after the assessment of livelihood options will act as the critical choice sets of bricolages for deciding resource mobilisation for RSM. It is discussed in detail in the next section.

Table 5. The Sustainable Livelihood Assessment (SLA) framework for focussed bricolage.

Asset/ Capital	Parameter	Factors	Status (Field survey results)	Bricolage variables
Natural	Resources Stock	Land	Fertile, flat terrain, no forests cover; Best vegetable producer in the area; Very high production of soybean, cotton, sugarcane and jowar; Open defecation	Cold storage facilities, Community toilets.

		Water	Scanty rainfall, No canal water, Low groundwater table, High salinity in drinking water	Rain Water Harvesting
		Biodiversity	Beautiful bird varieties, cattle	Cold storage for milk and milk products, agro-tourism
Physical	Infrastructure	Tools	Modern irrigation techniques like drip-irrigation system, mulching, etc.	Water security, jaggery processing, vegetable oil market
		Factories, Small Scale Enterprises	Sugar factory, primitive oil mill	
		Roads	Roads are not all-weather proof	Transportation frequency
		Electricity	Electrified with sporadic outages	Renewable energy application
Human	Capabilities	Physical	Hard-working, willingness to work	Skill development
		Skill	Retail, wholesale, export, fabrication	Market linkages and training
		Education	Majority 9th grade pass, few graduates and post graduates	Quality of education
		Health	Anaemic women, outages of diarrhoea	Indoor air pollution, good sanitation practices
Economic	Economic assets	Enterprises	Welding shops, fabrication shops, amla Processing, milk processing	Market linkages, seed-fund through SHGs and micro-finance
		Savings	Limited, inappropriate fund utilization, suspected foul play	
		Investments	No micro-finance model; no private (industry) investors	Financial training, micro-financing
Social	Provisions	Local Institutions	Markets, SHGs, Bureaucracy	Better co-ordination, project proposals
		Connectivity	Village has a 'Whtsapp' group	Sensitization about social-enterprises
		Empowerment	SHG are evolving to a larger group	Networking them through Information and Communication Technologies (ICT)

537

5. Development of RSM

The Resource Symbiosis Model (RSM) envisaged during the conceptual stage of this study is a cumulative assessment of the five assets or the capital of the village, as per the SLA (see Table 5). The inclusion of people's perspectives in the assessment process through PRA (see Fig. 20), added a socio-technical attribute in the design process of the RSM. It formed a critical base parameter for a bricolage-driven RSM. Transect walks (see Fig 18 and 19), a village resource map (see Fig 20), problem ranking (see Fig 21) and PRA, along with cross-sectional household (HH) surveys (see Section 3.1) helped in understanding the socio-economic dynamics of the village. The inputs from the PRA activity calibrated the SLA framework, such that the proposed RSM fits-the-purpose, and pushes the village to sustainable rural development. This process of deriving a fit-for-purpose model of rural development through bricolage is the most significant contribution of this study that is easily replicable to other villages across the world. The ability of such RSM to engage the community in a participatory manner is the core driver of sustainable development.

SLA revealed that the livelihood generation in the village could be operationalised in four significant ways, namely, resolving drudgery of women and men, creating market linkages for surplus production, enabling efficient resource utilisation (like establishing cold storage), and fostering current-village enterprises to their strategic advantages. The significant drudgery that both the genders face is linked to the scarcity of water and low-income levels (see Fig. 21). These are the collective problems which need coherent solutions like investment in rainwater harvesting. Watershed management can improve the water stress in the area and enable in higher production of crops. However, the initial investments need to be strategically channelised: for example, SHGs can help with seed grants, topped-up with partial funds from the government through the National Rural Livelihood Mission (NRLM) or Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) (see Table 1). The profits from the cultivation can be used to repay the SHGs. Similarly, savings can be made through efficient resource utilisation, using bricolage. For example, if village local government and the village welfare committee can help SK with the initial seed fund for setting up a milk-processing unit (see Section 3.1.6), once this dairy-plant starts to generate profits,

563 the money can be used to foster other entrepreneurial avenues in the village. ES's vision of a 'farmer's
564 mall' to foster agro-tourism in the region can be realised through this model of resource symbiosis. The
565 farmer's mall can also accommodate SK's milk products, GK's amla products (see Fig 15) and open retail
566 units for crop surplus (especially for soybean, cotton, and sugarcane). Thus, eccentrically linking every
567 available resource with the best of its worth (enabling bricolage). This venture of a 'Farmer's Mall' can
568 foster agro-tourism in the region, which will attract foreign investments and reduce the dependency on the
569 trickle-down model of government investments (see Table 1). As the popularity of the mall increase, other
570 small enterprises (see Fig. 14) can also plug-in to sell their products, like home-made farming equipment
571 by the village welding shops, pottery. With the increase in footfall in the village, investments would flow
572 in the form of improved all-weather roads and better transportation system.

573 At this stage, it is worth revisiting the conceptual framework of RSM (see Fig 1) and establishes direct links
574 with the three-phases of RSM along with the current state of the village resource utilisation. The initial
575 financial support from SHGs and local/federal government to enable resource mobilisation can be attributed
576 to Phase-I of RSM (see Fig 1), where the village will take some time to establish an equilibrium between
577 village self-sufficiency and market-based wealth creation. This phase is marked by high resource
578 mobilisation and slower growth rate, but unlike trickle-down mechanism, this process will necessarily
579 mobilise people and products, indicating a bricolage-building stage. It may be followed by the perceived
580 farmer's mall, where a set process of efficient resource utilisation and market-linkages can be created. It
581 can create stable and long-term linkages between self-sufficiency in the village and surplus-selling to
582 market, thus, defining the Phase-II of RSM (see Fig 1). It will be the rapid phase of development, manifested
583 by better roads and transportation services, better education infrastructure and supporting infrastructure for
584 reducing water-stress. A better market will facilitate an optimal balance between the rate of resource
585 mobilisation and the rate of development in the region. With the setup of a successful agro-tourism industry,
586 the village will progress towards improving the quality of life by providing better employment, better

resource management, and better infrastructure development, marking the Phase-III of the RSM conceptual model.

However, during the transition from Phase-I to Phase-II, the peripheral problems of the village (see Fig. 20) must be addressed through such measures as improving health through investment in community toilets and cohesively preventing open defecation. Improvement of indoor air quality through efficient, low-cost kitchen design and installing an improved cookstove, and also monitoring on the alcoholism in the village. Maintaining a balance between the bricolage of human, social and natural resource of the village can foster bottom-up sustainable development.

5.1 Enabling Resource Symbiosis in the village: Present scenario

The RSM model deals with two core elements of livelihood generation: the first is the economic self-sufficiency through bricolage and the second is the market-based economic (wealth) generation. When the interaction lies within the boundaries of the village, self-sufficiency is more prominent whereas when the interactions happen with the external market, wealth generation is more prominent (see Fig 21). Symbiosis is primarily achieved through a balance between self-sufficiency and market-driven wealth generation.

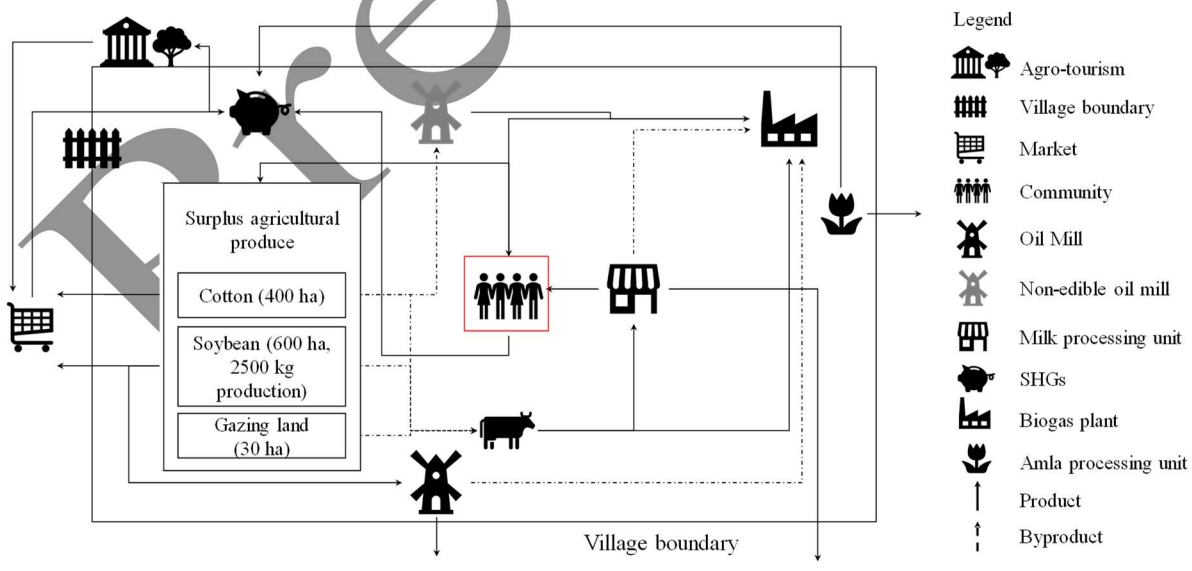


Fig. 21. Proposed Resource Symbiosis Model (RSM) for the village.

In Singnapur, around 600 hectares (ha) of land is involved in soybean cultivation, 400 ha for cotton cultivation and 30 ha is designated as the grazing land. The average productivity of soybean is 2500kg per ha. Each HH consumes around 3 litres of soybean oil every month (data collected through HH surveys). Soybean yields 446 litres of oil per ha (Vegetable oil yield, 2017). For the 920 households in the village, approximately, 33120 litres of oil per year is required. Therefore, a 75 ha of soybean cultivation is sufficient to meet the village's cooking-oil need. Thus, an entrepreneur can invest in 100 ha of land for soybean oil production, and after selling to the village, the remaining product can be sold to the external market for a premium. This analogy indicates a symbiosis between oil demand and wealth creation in the village.

The by-products of the oil mill can be used in a biogas plant, which would provide clean energy to the HH, which will reduce the firewood dependence and directly improving their overall health and well-being of the HH. It solves a vital problem of the village (see Fig 20). Similarly, the cotton seeds can be used to produce non-edible oil, which also can be fed to the biogas plant to generate clean energy. Also, the by-product of the oil mill can be used to feed the cattle population in the village, maintaining a balance between pasture grazing (30 ha) and oil-cakes from the oil mill. These oil-cakes can be sold at a marginal price, again creating a symbiosis model of self-sufficiency.

The village has a milk-producing cattle population of 1000. Each animal produces around 6 litres of milk per day, which is equal to 6000 litres. Now, based on our survey results it was found that each household consumes around 2 litres of milk daily. Thus, per day milk consumption in the village is 2000 litres and the remaining 4000 litres are often sold to the outside market immediately at a high logistic cost. It renders the milk-selling business with low-profitability. Intervention in the form of a milk-chilling unit of 5000 litres size can sufficiently store the milk for a longer duration. It would provide the time for processing the milk into higher value products. Thus, it expands the milk-product markets and promises higher profit. Our field surveys had revealed that there is a huge demand for organic and pure milk-products like cottage cheese, milk ice cream, and desserts in the nearby towns. Thus, setting up a 5000 litres milk chilling and processing facility seemed well-justified in the RSM framework.

A biogas plant of 1000 m3 capacity would be sufficient to run the oil mill and bulk-milk chilling plant of 5000 litres/day capacity with 2.23 kW (3 hp) and 3.73 kW (5 hp) motors, respectively. The waste generated in the biogas plant becomes the organic fertilisers for the agricultural fields, thereby contributing to the resource symbiosis process. Moreover, the electricity generated from the biogas plant for the community would also solve the problem of daily power outages that usually lasts for five hours. It can be noted that at every point of this RSM, livelihood options are created, followed by savings potential at the SHGs and micro-financing institutions; facilitating bricolage at each step.

However, the idea of 5000 litres per day milk-chilling facility seems ambitious, for the Phase-I of RSM, a 200 litres unit would suitably suffice the purpose. Thus, enabling adoption by such early entrepreneurs like ES and SK.

6. Conclusion

In this study, the concept of bricolage was leveraged for a novel Resource Symbiosis Model (RSM) for a village in India. The primary motivation of the RSM was the creation of a rural development process methodology that would efficiently utilise the available resources of the village sustainably. It would create pathways for co-management in a resource-constrained environment in collaboration with the local government. It was found that the village under study can benefit from bricolage by attaining economic self-sufficiency and establishing a market-based economic (wealth) generation system. It reduces the absolute dependency on the trickle-down government funds and broadens the scope of private investments with higher returns. The RSM enables a fit-for-purpose model of rural development that can be customised and reiterated as per the local socio-cultural needs. The learning from this study can be summarised as follows:

- Mapping of resources and problem identification through a participatory approach is a critical exercise for effective rural governance. It creates a contextual data platform often found missing in the national census databases.
- Identification of such critical stakeholders as natural influencers, early adopters, change drivers and gatekeepers within the community are critical steps for effective mobilisation of resources.
- Co-management is an important strategy is participatory rural development.
- Empowering the existing entrepreneurs and leveraging their efforts through institutional mechanisms is necessary for resource symbiosis.
- RSM could leverage local governing bodies to connect with private investors and policymakers to enable fast-track implementation of the livelihood generation schemes of the government.

This fit-for-purpose characteristic of RSM makes it an ideal addendum to such current rural development schemes of the government as the National Rural Livelihood Mission (NRLM) and the Integrated Rural Development Plan (IRDP) of the Ministry of Rural Development (MoRD). This study creates a structured goal-oriented livelihood generation framework for the study village which can foster an entrepreneurial ecosystem in the village. Future work would include testing the applicability of RSM for other villages across the country and generating a proof-of-concept for a generalised version of such a sustainable livelihood generation model. The authors would like the MoRD in India to adopt this model of rural planning and establish a process-driven method of sustainable development in the resource-constraint areas.

7. Acknowledgment

The authors would like to thank the Centre for Technology Alternatives for Rural Areas, Indian Institute of Technology Bombay for its support during the field survey stage of this study. Part of this study is funded by the Ministry of Human Resource Development (MHRD), the Government of India (GoI) project titled CoE-FAST, Grant No. 14MHRD005 and IRCC- IIT Bombay Fund, Grant No. 16IRCC561015. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the MHRD, GoI; CTARA-IIT Bombay and/or IRCC-IIT Bombay.

RD would like to thank the Commonwealth Scholarship Commission and Cambridge Trust for supporting him through Commonwealth Shared Scholarship 2017-18.

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